Course guide
295762 - 295EM122 - Biomedical Materials

Last modified: 04/06/2026

Unit in charge: Barcelona East School of Engineering
Teaching unit: 702 - CEM - Department of Materials Science and Engineering.

Degree: ERASMUS MUNDUS MASTER'S DEGREE IN ADVANCED MATERIALS SCIENCE AND ENGINEERING (Syllabus 2014). (Optional subject).
MASTER'S DEGREE IN MATERIALS SCIENCE AND ADVANCED MATERIALS ENGINEERING (Syllabus 2019). (Optional subject).
ERASMUS MUNDUS MASTER'S DEGREE IN ADVANCED MATERIALS SCIENCE AND ENGINEERING (Syllabus 2021). (Optional subject).

Academic year: 2026 **ECTS Credits:** 6.0 **Languages:** Spanish

LECTURER

Coordinating lecturer: MONTSERRAT ESPAÑOL PONS

Others: Segon quadrimestre:
MONTSERRAT ESPAÑOL PONS - Grup: T1
JOSE MARIA MANERO PLANELLA - Grup: T1

PRIOR SKILLS

Knowledge of biomaterials is recommended

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CEMCEAM-03. (ENG) Realizar estudios de caracterización y evaluación de materiales según sus aplicaciones
CEMCEAM-05. (ENG) Interpretar y aplicar normativas y especificaciones relativas a los materiales y sus aplicaciones

Transversal:
05 TEQ. TEAMWORK. Being able to work as a team player, either as a member or as a leader. Contributing to projects pragmatically and responsibly, by reaching commitments in accordance to the resources that are available.
06 URI. EFFECTIVE USE OF INFORMATION RESOURCES. Managing the acquisition, structure, analysis and display of information from the own field of specialization. Taking a critical stance with regard to the results obtained.

TEACHING METHODOLOGY

The subject includes classes in theoretical format and seminars. Attended activities will be carried out to work oral and written communication and team work through selected readings. Lab practices will also be carried out and autonomous learning and solvent use of information resources will be encouraged through non-contact directed activities.

LEARNING OBJECTIVES OF THE SUBJECT

The objective is that the student acquires knowledge of the applications of biomaterials in medicine and, therefore, be able to relate properties and biological response of biomaterials and apply selection criteria to determine the more suitable for application. In addition, the different techniques of biological characterization in vitro and in vivo of biomaterials are described, as well as the interpretation of the results obtained through the different techniques. The specific objectives are:
- Review the different types of biomaterials, their characteristics and biocompatibility.
- Knowledge of the basic principles of biological characterization in vitro and in vivo to evaluate biocompatibility of biomaterials.
- Description of the main applications of biomaterials in medicine

STUDY LOAD

Type	Hours	Percentage
Hours large group	28,0	18.67
Self study	108,0	72.00
Hours small group	14,0	9.33

Total learning time: 150 h

CONTENTS

Evaluation of the cell / biomaterial interaction

Description:
- Cell / biomaterial interaction, biocompatibility
- Type of cell cultures: primary crop, secondary crop, cultivation
- Basic cellular responses: adhesion, proliferation, differentiation and apoptosis
- Evaluation of the cytotoxicity of a biomaterial: measurements of metabolic activity (LDH, MTT) and trials based on the principle of cell exclusion (immunofluorescence, ELISA)
- Evaluation of the bacterial / biomaterial interaction
- Evaluation of blood / biomaterial interaction

Full-or-part-time: 35h
Practical classes: 6h
Laboratory classes: 3h
Guided activities: 2h
Self study : 24h

Biomedical materials for cardiovascular applications

Description:
- Cardiovascular diseases; Endothelialization and thrombogenicity
- Cardiovascular stents
- Heart valves
- Cardiovascular grafts

Full-or-part-time: 29h
Practical classes: 5h
Laboratory classes: 4h
Guided activities: 1h
Self study : 19h

Biomedical materials for dental and orthopedic applications

Description:

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- Biomaterials for bone replacement: inert metals and ceramics
- Dental implants. Prosthesis of hip and knee. Osteoisynthesis materials: plates and screws. Intervertebral disc
- Biomaterials for bone regeneration: bioceramics and bioavailable
- Biomaterials for condral repair and regeneration. Tissue engineering applied to orthopedic and maxillofacial surgery

Full-or-part-time: 34h
Practical classes: 6h
Laboratory classes: 3h
Guided activities: 1h
Self study : 24h

Biomedical materials for ophthalmic applications, skin, adhesives and sutures

Description:
- Biomaterials for ophthalmic applications: Anatomy of the eye; soft and hard contact lenses; intraocular lenses; corneal implants
- Biomaterials for applications for skin replacement: Structure of the dermis; permanent and reabsorbable implants; tissue engineering applied to skin regeneration
- Adhesives, sealants and sutures: adhesion mechanisms; composition and characteristics of adhesive materials; stickers for soft tissue; adhesives for hard tissues; natural and synthetic sutures

Full-or-part-time: 27h
Practical classes: 6h
Laboratory classes: 2h
Guided activities: 1h
Self study : 18h

Materiales biomédicos para la liberación controlada de fármacos

Description:
- Control of the release of a drug, between effectiveness and toxicity
- Control of release for dissemination
- Liberation control systems by penetration of water to the device
- Chemically controlled devices

Full-or-part-time: 25h
Practical classes: 5h
Laboratory classes: 2h
Guided activities: 1h
Self study : 17h

GRADING SYSTEM

Any academic fraud, plagiarism or use or possession of unauthorised means in an assessment activity leads to a mark of zero (0) for the affected test or assignment. Furthermore, in accordance with the University's regulations, if disciplinary proceedings are initiated the subject is recorded as "Pending Assessment" until a decision is reached. These incidents are managed in accordance with the **Action Framework for Academic Integrity in Assessment at the UPC**.

Nfinal=0,40*Nex final+0,40*Nex midterm+0,10*Laboratory+0,10*Work

In case of reassessment, Nfinal=0,80*Nex reassessment+0,10*Laboratory+0,10*Work

BIBLIOGRAPHY

Basic:
- Ratner, Buddy D. [et al.] (eds.). Biomaterials science : an introduction to materials in medicine. 3rd ed. Amsterdam: Elsevier/Academic Press, 2013. ISBN 9780123746269.

Complementary:
- Khurana, Jasvir S.; McCarthy, Edward F.; Zhang, Paul J. Essentials in bone and soft-tissue pathology [on line]. New York: Springer, [2010] [Consultation: 19/05/2020]. Available on: https://ebookcentral.proquest.com/lib/upcatalunya-ebooks/detail.action?docID=993468. ISBN 9780387898452.
- Agrawal, C. Mauli [et al.]. Introduction to biomaterials : basic theory with engineering applications. Cambridge: Cambridge University Press, 2014. ISBN 9780521116909.

RESOURCES

Audiovisual material:
- Presentacions en PPT. Presentations in PPT